Faculty of Resource Science and Technology

Systematic and Conservation Studies of *Dipterocarpus* Gaertn. f. (Dipterocarpaceae) in Sarawak

Ogary Kinshen Migas

Master of Science
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Systematic and Conservation Studies of *Dipterocarpus* Gaertn. f. (Dipterocarpaceae) in Sarawak

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A thesis submitted

In fulfillment of the requirements for the degree of Master of Science (Botany)

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Final Year Project Report ☐

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DEDICATION

I dedicate this work to the very first forester, I have ever met, whom I wish I have had more time with, Mr. Migas Nimbun; and to the family and extended family members that almost always caught me off-guard with questions on the genus *Dipterocarpus* and the state of forestry in Sarawak as a whole.

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ABSTRACT

There are a total of 35 taxa of *Dipterocarpus* comprising of 27 species and 8 subspecies occurring in Sarawak. The species included were *Dipterocarpus acutangulus* Vesque, *D. applanatus* Slooten, *D. borneensis* Slooten, *D. caudiferus* Merr., *D. confertus* Slooten, *D. coriaceous* Slooten, *D. costulatus* Slooten, *D. crinitus* Dyer, *D.cuspidatus* P.S. Ashton, *D.elongatus* Korth., *D. eurynchus* Miq., *D. fagineus* Vesque, *D. glabrigemmatus* P.S. Ashton, *D. globosus* Vesque, *D. gracilis* Blume, D. *humeratus* Slooten, *D. kunsteri* King, *D. lowii* Hook f., *D. mundus* Slooten, *D. nudus* Vesque, *D. oblongifolius* Blume, *D. pachyphyllus* Meijer, *D. rigidus* Ridl., *D. sarawakensis* F.G. Brown *ex* Slooten, *D. sublamellatus* Fowx., *D. tempehes* Slooten and *D. verrucosus* Foxw. *ex* Slooten. The eight subspecies included were *D. caudatus* ssp. *peniangianus* Fowx., *D. conformis* Slooten ssp. *borneensis* P.S Ashton, *D. geniculatus* Vesque ssp. *geniculatus* Vesque, *D. geniculatus* Vesque ssp. *grandis* P.S Ashton, *D. palembanicus* Slooten ssp. *borneensis* P.S Ashton, *D. palembanicus* Slooten ssp. *palembanicus* Slooten, *D. stellatus* Vesque ssp. *stellatus, and D. stellatus* Vesque ssp. *parvus* P.S. Ashton. The first aspect of this study includes morphological observations based on herbarium specimens deposited at Sarawak Herbarium (SAR), Herbarium UNIMAS (HUMS), and specimens collected from the field. The second aspect include anatomical studies focused on the leaf microstructures, particularly the stomata types and epidermal cell features of the selected *Dipterocarpus* spp. This aspect of studies involved leaf clearing method for light microscopy observations and investigation of the microstructures using the Scanning Electron Microscope (SEM). The third aspect involved examination of pollen microstructures of the selected *Dipterocarpus* spp. under the SEM. Morphological characteristics of 35 taxa of *Dipterocarpus* were described and documented as an updated of the previous study by Ashton,

2004. Based on the herbarium specimens and field observation made, description of the species and key for the species identification are included. The main morphological characteristics that distinguished the species and subspecies within the genus *Dipterocarpus* are the leaf and the fruit characteristics. The microstructures of the leaves based on the seven species investigated, depicts that the stomata types are also considered additional new information and are good characteristics for species and subspecies identification. All the species investigated have hypostomatic leaf, anomocytic, anomo-cyclocytic, and paracytic stomata types. The pollen of the nine species investigated were of spheroidal-shaped, with reticulate exine and diameter size ranges 48.0 – 63.0 μm. The conservation status of the *Dipterocarpus* spp. are included based on the Sarawak Plant Red List, Plant Red List Peninsular Malaysia, and IUCN Red List (2013). Of all the species, *Dipterocarpus oblongifolius* is one of the two totally protected plant species in Sarawak under the Sarawak Wildlife Ordinance 1998. This species has been listed as totally protected plant species due to its ecological importance and key stone species for the terrestrial and aquatic wildlife. There are three *Dipterocarpus* spp. recorded as endangered and 13 as critically endangered based on the IUCN Red List 2013. The ecological notes, distribution and the conservation status from the three lists will be very important for future conservation management especially to the endangered and critically endangered species as to avoid local extinction.

Keywords: *Dipterocarpus*, morphology, anatomy, palynology, conservation, Sarawak

Kajian Sistematik dan Status Pemuliharaan Dipterocarpus Gaertn. f. (Dipterocarpaceae) di Sarawak

ABSTRAK

Terdapat sejumlah 35 taxa Dipterocarpus yang terdiri daripada 27 spesies dan 8 sub-spesies yang direkod di Sarawak. Spesies yang dikaji ini adalah Dipterocarpus acutangulus Vesque, D. applanatus Slooten, D. borneensis Slooten, D. caudiferus Merr., D. confertus Slooten, D. coriaceous Slooten, D. costulatus Slooten, D. crinitus Dyer, D.cuspidatus P.S. Ashton, D. elongatus Korth., D. eurynchus Miq., D. fagineus Vesque, D. glabrigemmatus P.S. Ashton, D. globosus Vesque, D. gracilis Blume, D. humeratus Slooten, D. kunsteri King, D. lowii Hook f., D. mundus Slooten, D. nudus Vesque, D. oblongifolius Blume, D. pachyphyllus Meijer, D. rigidus Ridl., D. sarawakensis F.G. Brown ex Slooten, D. sublamellatus Fowx., D. tempehes Slooten and D. verrucosus Foxw. ex Slooten. Lapan sub-spesies yang dikaji adalah D. caudatus ssp. peniangianus Fowx., D. conformis Slooten ssp. borneensis P.S Ashton, D. geniculatus Vesque ssp. geniculatus Vesque, D. geniculatus Vesque ssp. grandis P.S Ashton, D. palembanicus Slooten ssp. borneensis P.S Ashton, D. palembanicus Slooten ssp. palembanicus Slooten, D. stellatus Vesque ssp. stellatus, dan D. stellatus Vesque ssp. parvus P.S. Ashton. Aspek pertama dalam kajian ini melibatkan pemerhatian morfologi berdasarkan spesimen herbarium yang ditempatkan di Sarawak Herbarium (SAR), Herbarium UNIMAS (HUMS), dan spesimen yang diperolehi dari koleksi lapangan. Aspek kedua melibatkan kajian anatomi yang mengfokuskan kepada struktur mikro daun, terutamanya jenis stoma dan keadaan sel epidermis dari beberapa Dipterocarpus spp. terpilih. Aspek kajian ini melibatkan kaedah leaf clearing untuk pemerhatian dengan mikroskop cahaya dan kajian struktur mikro menggunakan Mikroskop Imbasan Elektron (SEM). Aspek ketiga

melibatkan kajian struktur mikro debunga dari beberapa Dipterocarpus spp. terpilih dengan penggunaan SEM. Ciri-ciri morfologi dari 35 taxa Dipterocarpus telah dinyatakan dan dicatit sebagai kemas kini kepada kajian sebelum ini oleh Ashton, 2004. Berdasarkan spesimen herbarium dan pemerhatian lapangan yang dibuat, catitan spesies dan kunci bagi pengenalan spesies diturutkan serta. Ciri-ciri morfologi induk yang mengasingkan spesies dan sub-spesies dalam genus Dipterocarpus adalah daun dan ciri buahnya. Struktur mikro daun berdasarkan tujuh spesies yang dikaji, menunjuk jenis stomata sebagai informasi baharu dan menjadi ciri yang baik bagi pengenalan spesies dan sub-spesies. Semua spesies yang dikaji diperhatikan memperoleh jenis stoma daun hipostomatik, anomositik, anomo-siklositik, dan parasitik. Debunga dari sembilan mempunyai bentuk sfera, dengan reticulate exine dan saiz diameter di antara 48 – 63 µm. Status pemuliharaan Dipterocarpus spp. turut dinyatakan berdasarkan Sarawak Plant Red List, Plant Red List Peninsular Malaysia, IUCN Red List (2013). Daripada kesemua spesies Dipterocarpus, cuma Dipterocarpus oblongifolius sahaja dikategorikan sebagai salah satu daripada dua tumbuhan terlindung sepenuhnya disebabkan oleh kepentingan ekologinya dan status "key stone" spesies untuk hidupan darat dan akuatik. Terdapat tiga spesies Dipterocarpus direkodkan sebagai "endangered", dan 13 sebagai "critically endangered" berdasarkan IUCN Red List 2013. Nota ekologi, taburan, dan status pemuliharaan dari tiga senarai tersebut akan menjadi sangat penting untuk projek pemuliharaan masa akan datang, terutamanya untuk spesies "endangered" dan "critically endangered" bagi mengelakkan kepupusan setempat.

***Kata kunci**: Dipterocarpus, morfologi, anatomi, palinologi, pemuliharaan, Sarawak*

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LIST OF ABBREVIATIONS

µm	micrometer
CIRAD	Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement (French)
cm	centimeter
cu m	cubic meter
dbh	diameter at breast height
FAO	Food and Agriculture Organisation
ha	hectare
Indum.	indumentum
ITP	Industrial Tree Plantation
IUCN	International Union for Conservation of Nature and Natural Resources
kg	kilogram
LM	Light Microscope
LPF	License for Planted Forest
m	meter
mil	million
mL	milliliter
mm	millimeter
MUS	Malayan Uniform System
NCR	Native Customary Right
nm	nanometer
NP	National Park